

IN THE CLAIMS

This listing of the claim will replace all prior versions and listings of claim in the present application.

Listing of Claims

1. (currently amended) A disk array device comprising:
 - a plurality of input/output channels that receive data input/output requests from at least one external device;
 - a plurality of cache memories provided for the corresponding respective input/output channels, each of the cache memories connected to each of the corresponding respective input/output channels;
 - a disk drive device;
 - a disk control module that performs data input/output to and from the disk drive device;
 - at least one communication module that communicatively connects the input/output channels with the disk control module; and
 - a control module that controls, upon receiving a data input/output request from the at least one external device, a sequence of execution of a first operation of a response processing to respond to the at least one external device according to the data input/output request and a second operation of a consistency maintaining processing to maintain consistency of data stored in each of the cache memories such that one of said first and second operations is executed first and the other of said first and second operations is executed second;
- wherein an analysis of the data input/output request is performed to determine whether maintaining consistency of data stored in each cache

memory is necessary and the sequence of execution is controlled so that said first operation is executed first if maintaining consistency is not necessary.

2. (currently amended) A disk array device according to claim 1, further comprising:

a consistency maintaining module that performs the consistency maintaining processing to maintain consistency of data stored in each of the cache memories.

3. (currently amended) A disk array device comprising:

a plurality of input/output channels that receive data input/output requests from at least one external device;

a plurality of cache memories provided for the corresponding respective input/output channels, each of the cache memories connected to each of the corresponding respective input/output channels;

a disk drive device;

a disk control module that performs data input/output to and from the disk drive device;

at least one communication module that communicatively connects the input/output channels with the disk control module; and

a control module that controls, upon receiving a data input/output request from the at least one external device, a sequence of execution of a first operation of a response processing to respond to the at least one external device according to the data input/output request and a second operation of a consistency maintaining processing to maintain consistency of data stored in

each of the cache memories such that one of said first and second operations is executed first and the other of said first and second operations is executed second
A disk array device according to claim 2,

wherein a consistency maintaining module performs the consistency maintaining processing to maintain consistency of data stored in each of the cache memories, and

wherein the consistency maintaining module performs the consistency maintaining processing depending on a content of the data input/output request.

4. (original) A disk array device according to claim 3, wherein the consistency maintaining module performs the consistency maintaining processing first depending on a content of the data input/output request, and then a response processing to the external device is executed.

Claim 5 (canceled).

6. (original) A disk array device according to claim 1, wherein, when data stored in one of the cache memories is updated, the consistency maintaining module invalidates data stored in at least another one of the cache memories.

7. (currently amended) A disk array device comprising:
a plurality of input/output channels that receive data input/output requests from at least one external device;

a plurality of cache memories provided for the corresponding respective input/output channels, each of the cache memories connected to each of the corresponding respective input/output channels;

a disk drive device;

a disk control module that performs data input/output to and from the disk drive device;

at least one communication module that communicatively connects the input/output channels with the disk control module; and

a control module that controls, upon receiving a data input/output request from the at least one external device, ~~an~~ a sequence of execution order of a first operation of a response processing to respond to the at least one external device according to the data input/output request and a second operation of a consistency maintaining processing to maintain consistency of data stored in each of the cache memories such that one of said first and second operations is executed first and the other of said first and second operations is executed second,

wherein, when data stored in one of the cache memories is updated, ~~the~~ a consistency maintaining module invalidates data stored in at least another one of the cache memories, and

wherein the data stored in the one of the cache memories and the data stored in the at least another one of the cache memories are stored in an identical storage region of the disk drive device, and

wherein an analysis of the data input/output request is performed to determine whether maintaining consistency of data stored in each cache

memory is necessary and the sequence of execution is controlled so that said first operation is executed first if maintaining consistency is not necessary.

8. (currently amended) A disk array device according to claim 1, wherein, when data stored in one of the cache memories is updated, ~~the~~ a consistency maintaining module updates data stored in at least another one of the cache memories.

9. (currently amended) A disk array device comprising:

- a plurality of input/output channels that receive data input/output requests from at least one external device;
- a plurality of cache memories provided for the corresponding respective input/output channels, each of the cache memories connected to each of the corresponding respective input/output channels;
- a disk drive device;
- a disk control module that performs data input/output to and from the disk drive device;
- at least one communication module that communicatively connects the input/output channels with the disk control module; and
- a control module that controls, upon receiving a data input/output request from the at least one external device, ~~an~~ a sequence of execution order of a first operation of a response processing to respond to the at least one external device according to the data input/output request and a second operation of a consistency maintaining processing to maintain consistency of data stored in each of the cache memories such that one of said first and

second operations is executed first and the other of said first and second operations is executed second,

~~wherein, when data stored in one of the cache memories is updated, the consistency maintaining module updates data stored in at least another one of the cache memories, and~~

wherein the data stored in the one of the cache memories and the data stored in the at least another one of the cache memories are stored in an identical storage region of the disk drive device-, and

wherein an analysis of the data input/output request is performed to determine whether maintaining consistency of data stored in each cache memory is necessary and the sequence of execution is controlled so that said first operation is executed first if maintaining consistency is not necessary.

10. (currently amended) A disk array device comprising:

a plurality of input/output channels that receive data input/output requests from at least one external device;

a plurality of cache memories provided for the corresponding respective input/output channels, each of the cache memories connected to each of the corresponding respective input/output channels;

a disk drive device;

a disk control module that performs data input/output to and from the disk drive device;

a communication module that communicatively connects the input/output channels with the disk control module;

a consistency maintaining module that performs a consistency maintaining processing to maintain consistency of data stored in each of the cache memories; and

a control module that controls, upon receiving a data input/output request from the at least one external device, a sequence of execution of a first operation of a response processing to respond to the at least one external device according to the data input/output request and a second operation of the consistency maintaining processing such that one of said first and second operations is executed first and the other of said first and operations is executed second,

wherein an analysis of the data input/output request is performed to determine whether maintaining consistency of data stored in each cache memory is necessary and the sequence of execution is controlled so that said first operation is executed first if maintaining consistency is not necessary.

11. (original) A disk array device according to claim 10, wherein, when data stored in one of the cache memories is updated, the consistency maintaining module invalidates data stored in at least another one of the cache memories.

12. (currently amended) A disk array device comprising:
a plurality of input/output channels that receive data input/output requests from at least one external device;

a plurality of cache memories provided for the corresponding respective input/output channels, each of the cache memories connected to each of the corresponding respective input/output channels;

a disk drive device;

a disk control module that performs data input/output to and from the disk drive device;

a communication module that communicatively connects the input/output channels with the disk control module;

a consistency maintaining module that performs a consistency maintaining processing to maintain consistency of data stored in each of the cache memories; and

a control module that controls, upon receiving a data input/output request from the at least one external device, an a sequence of execution order of a first operation of a response processing to respond to the at least one external device according to the data input/output request and a second operation of the consistency maintaining processing such that one of said first and second operations is executed first and the other of said first and second operations is executed second,

wherein, when data stored in one of the cache memories is updated, the consistency maintaining module invalidates data stored in at least another one of the cache memories, and

wherein the data stored in the one of the cache memories and the data stored in the at least another one of the cache memories are stored in an identical storage region of the disk drive device, and

wherein an analysis of the data input/output request is performed to determine whether maintaining consistency of data stored in each cache memory is necessary and the sequence of execution is controlled so that said first operation is executed first if maintaining consistency is not necessary.

13. (original) A disk array device according to claim 10, wherein, when data stored in one of the cache memories is to be updated, the data stored in the one of the cache memories is updated and data stored in at least another one of the cache memories is also updated.

14. (currently amended) A disk array device comprising:

- a plurality of input/output channels that receive data input/output requests from at least one external device;
- a plurality of cache memories provided for the corresponding respective input/output channels, each of the cache memories connected to each of the corresponding respective input/output channels;
- a disk drive device;
- a disk control module that performs data input/output to and from the disk drive device;
- a communication module that communicatively connects the input/output channels with the disk control module;
- a consistency maintaining module that performs a consistency maintaining processing to maintain consistency of data stored in each of the cache memories; and

a control module that controls, upon receiving a data input/output request from the at least one external device, ~~an~~ a sequence of execution order of a first operation of a response processing to respond to the at least one external device according to the data input/output request and a second operation of the consistency maintaining processing such that one of said first and second operations is executed first and the other of said first and second operations is executed second,

wherein, when data stored in one of the cache memories is to be updated, the data stored in the one of the cache memories is updated and data stored in at least another one of the cache memories is also updated, and

wherein the data stored in the one of the cache memories and the data stored in the at least another one of the cache memories are stored in an identical storage region of the disk drive device, and

wherein an analysis of the data input/output request is performed to determine whether maintaining consistency of data stored in each cache memory is necessary and the sequence of execution is controlled so that said first operation is executed first if maintaining consistency is not necessary.

15. (currently amended) A disk array device comprising:
a plurality of input/output channels that receive data input/output requests from at least one external device;
a plurality of cache memories provided for the corresponding respective input/output channels, each of the cache memories connected to each of the corresponding respective input/output channels;

a disk drive device;

a disk control module that performs data input/output to and from the disk drive device;

a communication module that communicatively connects the input/output channels with the disk control module;

a consistency maintaining module that performs a consistency maintaining processing to maintain consistency of data stored in each of the cache memories; and

a control module that controls, upon receiving a data input/output request from the at least one external device, a sequence of execution of a first operation of a response processing to respond to the at least one external device according to the data input/output request and a second operation of the consistency maintaining processing such that one of said first and second operations is executed first and the other of said first and operations is executed second~~A disk array device according to claim 10,~~

wherein a plurality of logical volumes of logical storage regions is set on a storage region of the disk drive device, the data input/output request includes an identifier for identifying at least one of the logical volumes that is a subject of the data input/output request, and further comprising a module that performs the control of the execution order according to the identifier included in the data input/output request.

16. (currently amended) A disk array device comprising:

a plurality of input/output channels that receive data input/output requests from at least one external device;

a plurality of cache memories provided for the corresponding
respective input/output channels, each of the cache memories connected to
each of the corresponding respective input/output channels;

a disk drive device;

a disk control module that performs data input/output to and from the
disk drive device;

a communication module that communicatively connects the
input/output channels with the disk control module;

a consistency maintaining module that performs a consistency
maintaining processing to maintain consistency of data stored in each of the
cache memories;

a control module that controls, upon receiving a data input/output
request from the at least one external device, a sequence of execution of a
first operation of a response processing to respond to the at least one external
device according to the data input/output request and a second operation of
the consistency maintaining processing such that one of said first and second
operations is executed first and the other of said first and operations is
executed second;~~A disk array device according to claim 10, further~~
comprising:

a module that connects to another disk array device; and

a module that, upon receiving a data write request as the data
input/output request, writes data designated by the data write request in the
disk drive device, and sends a write request for the data to the other disk
array device.

17. (original) A disk array device according to claim 16, wherein each of the input/output channels, upon receiving a data write request, operates in one of a write operation mode to write data in the disk drive device and a request send operation mode to send the write request to the other disk array, and further comprising a module that performs the control of the execution order depending on which one of the write operation mode and the request send operation mode one of the input/output channels that receives the data input/output request is operating in.

18. (currently amended) A method for controlling a disk array device, the disk array device comprising a plurality of input/output channels that receive data input/output requests from at least one external device, a plurality of cache memories provided for the corresponding respective input/output channels, each of the cache memories connected to each of the corresponding respective input/output channels, a disk drive device, a disk control module that performs data input/output to and from the disk drive device, a communication module that communicatively connects the input/output channels with the disk control module, and a consistency maintaining module that performs a consistency maintaining processing to maintain consistency of data stored in each of the cache memories, the controlling method comprising the steps of:

receiving a data input/output request from the at least one external device; and

controlling a sequence of execution of a first operation of a response processing to respond to the at least one external device according to the

data input/output request and a second operation of the consistency maintaining processing such that one of said first and second operations is executed first and the other of said first and second operations is executed second.

wherein an analysis of the data input/output request is performed to determine whether maintaining consistency of data stored in each cache memory is necessary and the sequence of execution is controlled so that said first operation is executed first if maintaining consistency is not necessary.

19. (currently amended) A method for controlling a disk array device, the disk array device comprising a plurality of input/output channels that receive data input/output requests from at least one external device, a plurality of cache memories provided for the corresponding respective input/output channels, each of the cache memories connected to each of the corresponding respective input/output channels, a disk drive device, a disk control module that performs data input/output to and from the disk drive device, a communication module that communicatively connects the input/output channels with the disk control module, and a consistency maintaining module that performs a consistency maintaining processing to maintain consistency of data stored in each of the cache memories, the controlling method comprising the steps of:

receiving a data input/output request from the at least one external device; and

controlling an execution order of a response processing to respond to the at least one external device according to the data input/output request and the consistency maintaining processing,

wherein the consistency maintaining processing includes the step of, upon updating data stored in one of the cache memories, invalidating data stored in at least another one of the cache memories wherein the data stored in the at least another one of the cache memories is stored in an identical storage region of the disk drive device that stores the data stored in the one of the cache memory, and

wherein an analysis of the data input/output request is performed to determine whether maintaining consistency of data stored in each cache memory is necessary and the sequence of execution is controlled so that said first operation is executed first if maintaining consistency is not necessary.

20. (currently amended) A method for controlling a disk array device, the disk array device comprising a plurality of input/output channels that receive data input/output requests from at least one external device, a plurality of cache memories provided for the corresponding respective input/output channels, each of the cache memories connected to each of the corresponding respective input/output channels, a disk drive device, a disk control module that performs data input/output to and from the disk drive device, a communication module that communicatively connects the input/output channels with the disk control module, and a consistency maintaining module that performs a consistency maintaining processing to

maintain consistency of data stored in each of the cache memories, the controlling method comprising the steps of:

receiving a data input/output request from the at least one external device; and

controlling ~~an~~ a sequence of execution order of a first operation of a response processing to respond to the at least one external device according to the data input/output request and a second operation of the consistency maintaining processing such that one of said first and second operations is executed first and the other of said first and second operations is executed second,

wherein the consistency maintaining processing includes the step of, upon updating data stored in one of the cache memories, updating data stored in at least another one of the cache memories wherein the data stored in the at least another one of the cache memories is stored in an identical storage region of the disk drive device that stores the data stored in the one of the cache memory-, and

wherein an analysis of the data input/output request is performed to determine whether maintaining consistency of data stored in each cache memory is necessary and the sequence of execution is controlled so that said first operation is executed first if maintaining consistency is not necessary.

21. (currently amended) A method for controlling a disk array device, the disk array device comprising a plurality of input/output channels that receive data input/output requests from at least one external device, a plurality of cache memories provided for the corresponding respective

input/output channels, each of the cache memories connected to each of the corresponding respective input/output channels, a disk drive device, a disk control module that performs data input/output to and from the disk drive device, a communication module that communicatively connects the input/output channels with the disk control module, and a consistency maintaining module that performs a consistency maintaining processing to maintain consistency of data stored in each of the cache memories, the controlling method comprising the steps of:

receiving a data input/output request from the at least one external device; and

controlling a sequence of execution of a first operation of a response processing to respond to the at least one external device according to the data input/output request and a second operation of the consistency maintaining processing such that one of said first and second operations is executed first and the other of said first and second operations is executed second~~A method for controlling a disk array device according to claim 18,~~

wherein a plurality of logical volumes of logical storage regions is set on a storage region of the disk drive device, the data input/output request includes an identifier for identifying at least one of the logical volumes that is a subject of the data input/output request, and the control of the execution order is conducted according to the identifier included in the data input/output request.

22. (currently amended)A method for controlling a disk array device, the disk array device comprising a plurality of input/output channels that

receive data input/output requests from at least one external device, a plurality of cache memories provided for the corresponding respective input/output channels, each of the cache memories connected to each of the corresponding respective input/output channels, a disk drive device, a disk control module that performs data input/output to and from the disk drive device, a communication module that communicatively connects the input/output channels with the disk control module, and a consistency maintaining module that performs a consistency maintaining processing to maintain consistency of data stored in each of the cache memories, the controlling method comprising the steps of:

receiving a data input/output request from the at least one external device; and

controlling a sequence of execution of a first operation of a response processing to respond to the at least one external device according to the data input/output request and a second operation of the consistency maintaining processing such that one of said first and second operations is executed first and the other of said first and second operations is executed second
A method for controlling a disk array device according to claim 18,

wherein the disk array device connects to another disk array device, and further comprising the steps of upon receiving a data write request as the data input/output request, writing data designated by the data write request in the disk drive device, and sending a write request for the data to the other disk array device.

23. (original) A method for controlling a disk array device according to claim 22, wherein each of the input/output channels, upon receiving a data write request, operates in one of a write operation mode to write data in the disk drive device and a request send operation mode to send the write request to the other disk array, and the control of the execution order is conducted depending on which one of the write operation mode and the request send operation mode one of the input/output channels that receives the data input/output request is operating in.

24. (currently amended) A storage system comprising:
at least one external device; and
a disk array device including a plurality of input/output channels that receive data input/output requests from at least one external device, a plurality of cache memories provided for the corresponding respective input/output channels, each of the cache memories connected to each of the corresponding respective input/output channels, a disk drive device, a disk control module that performs data input/output to and from the disk drive device, a communication module that communicatively connects the input/output channels with the disk control module, and a consistency maintaining module that performs a consistency maintaining processing to maintain consistency of data stored in each of the cache memories,
wherein the disk array device includes a control module that controls, upon receiving a data input/output request from the at least one external device, a sequence of execution of a first operation of a response processing to respond to the at least one external device according to the data

input/output request and a second operation of the consistency maintaining processing such that one of said first and second operations is executed first and the other of said first and second operations is executed second.

wherein an analysis of the data input/output request is performed to determine whether maintaining consistency of data stored in each cache memory is necessary and the sequence of execution is controlled so that said first operation is executed first if maintaining consistency is not necessary.